



QUESTION WORKBOOK

Data communication

Electronics · Year 13

AQA 3.13.4

17 questions · 51 marks

NAVY SCREEN EDITION

SECTION A · Warm-up

A1 State what is meant by baseband transmission, and give two reasons a radio station modulates a carrier instead. [2]

A2 A carrier of frequency f_c is amplitude modulated by a single audio tone of frequency f_m . State the frequencies transmitted. [2]

A3 Write down the equation for the bandwidth of an amplitude-modulated transmission, and state what the symbol in it means. [2]

A4 Write down the equation for the bandwidth of a frequency-modulated transmission, and state what each symbol means. [2]

- A5** State the rule that fixes the minimum sampling rate for an analogue signal, and state what goes wrong if the rule is broken. [2]

- A6** Distinguish between time-division and frequency-division multiplexing. [2]

SECTION B · Standard

- B1** A station transmits by amplitude modulation on a carrier of 1.53 MHz, carrying audio up to 5.0 kHz. Calculate the frequencies of the two sidebands and the bandwidth of the transmission. [3]

- B2** A two-way radio uses frequency modulation with a deviation of 5.0 kHz and speech limited to 3.5 kHz. Calculate its bandwidth. [3]

- B3** A compact disc carries two channels of audio, each limited to 20 kHz, sampled at 44.1 kHz with 16 bits per sample. Show that the sampling rate is adequate, and calculate the total bit rate. [3]

- B4** An analogue-to-digital converter uses 12 bits per sample over an input range of 5.0 V. Calculate the number of quantisation levels and the size of one step. [3]

- B5** Thirty digital telephone calls, each running at 64 kbit s^{-1} , are carried on one cable by time-division multiplexing. Calculate the bit rate the cable must carry, and state what each call is given by the multiplexer. [3]

- B6** A broadcasting authority has an allocation 2.0 MHz wide for amplitude-modulated stations spaced 9 kHz apart. Calculate the number of stations that fit. [3]

- B7** Calculate the wavelength of a 3.0 kHz radio wave and of a 100 MHz carrier, and state what this says about aerial length. [2]

SECTION C · Stretch

- C1** A broadcast band runs from 88.0 MHz to 91.0 MHz. Stations use frequency modulation carrying audio up to 15 kHz with a deviation of 75 kHz, and each channel is allowed a 20 kHz guard band on top of its own bandwidth. Calculate the bandwidth per station, the channel spacing and the number of stations the band holds. Then calculate the same three figures if the deviation is reduced to 25 kHz, and state what is lost by the change. [7]

- C2** Telephone speech is limited to 3.4 kHz and sampled at 8.0 kHz. Calculate the bit rate with 8 bits per sample and with 12 bits per sample, and state the effect of the change on the quantisation error. [4]

- C3** A signal containing a 7.0 kHz tone is sampled at 10 kHz. State whether the sampling rate is adequate, calculate the frequency at which the tone appears in the reconstructed signal, and calculate the minimum acceptable sampling rate.

[4]

- C4** An authority has 2.0 MHz of spectrum and wants 40 channels in it. Calculate the width available per channel. Determine whether amplitude modulation carrying audio to 4.5 kHz would fit, and whether frequency modulation with a deviation of 20 kHz carrying the same audio would fit. Recommend one scheme with a reason.

[4]